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Can constitutions bring about revolutions? How to enhance decarbonization success

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ABSTRACT

Climate policy-making and decarbonization require instruments to create and manage economic expectations. There is increasing concern that the existing panoply of domestic (emission trading schemes, regulation, taxes) and external instruments (climate change treaties) be insufficient to anchor expectations to decarbonization and isolate abatement policies from risk to be reneged or insufficiently implemented. The paper argues that constitutional provisions could represent the help policymakers need in committing to combat climate change and setting their policy goals in a low-carbon direction. This role is empirically confirmed by applying a pooled OLS on a sample of 168 countries covering different geographic areas over the period 2010–2014. We also confirm the role of multi-level governance in disciplining carbon emissions and advocate for the right to atmospheric integrity to be embedded at EU treaty level.

1. Introduction

In 2016, the global average surface temperature set a new record and the year was the warmest since modern recordkeeping (1880); 2017 was the second hottest year globally. This is part of a trend of increased global temperature - global warming - whose dominant cause is to be ascribed to human activities, especially the employment of fossil fuels for energy production. Global warming is caused by the concentration of carbo-dioxide (CO2) and other air pollutants and greenhouse gases (GHG) in the atmosphere, absorbing sunlight and solar radiations that bounce off the earth's surface. CO2 concentration has reached more than 410 ppm rising at a rate of 2 ppm per year above pre-industrial levels (300 ppm)[1]. It has already increased the average global surface temperature by 0.9 °C relative to 1951–1980 average temperatures,[2] causing severe weather anomalies. A further increase to 450 ppm would likely increase the average global temperature by 2 °C in 2040-50 and intensify extreme weather events bringing about reduced food production, increased ill health in humans, animals and plants, loss of ecosystems and biodiversity, Arctic and Antarctic ice loss and sea-level rise.

According to the Intergovernmental Panel on Climate Change, to keep the average global temperature increase within 2 °C, GHG and net carbon emissions should be reduced to zero by the end of the XXI century and by 2065-85, respectively. This means that the world economy will have to decarbonize completely. The Paris Agreement (2015) has increased the level of ambition and set the goal to limit the temperature increase to 1.5 °C. These targets require a technological revolution and a radical change in all GHG and carbon emitting sectors, overcoming the current high-carbon dependence of the economic systems.

The global dimension of climate change implies that no single country can prevent the concentration of CO2 from rising to dangerous levels, nor generate large-scale processes of structural change so to achieve the required scale and speed of decarbonization. Indeed, decarbonization belongs to the challenging category of global public goods, whose effects are of global reach and/or extend beyond generations creating complex problems of collective decision-making and provision. Even when international treaties on climate change are signed, their implementation is hard to sustain, when confronted with domestic institutional obstacles and interest group pressures.

To achieve the broad policy efforts required by climate change, governments rely on the instruments forged to answer environmental problems, namely regulatory measures and market-based policy tools (fees, pollution taxes, subsidies, emissions trading schemes-ETS).

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[1] https://www.esrl.noaa.gov.

[2] http://climate.nasa.gov/.

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However, there is a growing sense of concern about the adequacy of existing actions to alter the course of climate change (IPCC, 2018[3]; European Council, 2018): progress in decarbonization is incremental, piecemeal, and falls short of the pace and scale needed (NCE, 2018). Carbon prices from carbon taxes or ETS are still too low (OECD, 2018a) to drive a radical transformation towards clean technologies; global emissions in the energy sector grew by 1.4% in 2017 after three years of flat trend[4]; subsidies to fossil fuel production and consumption globally are still over US$250 billion per year (OECD, 2018b). Even in the European Union (EU), which has the most ambitious targets to counter climate change (a 35% cut in GHG emissions below 1990 levels by 2030), decarbonization is slow and faces a key obstacle in transport emissions, which on average have risen by 23% above their 1990 levels.

Enforcing a strong precautionary policy of decarbonization requires a broader, more comprehensive and integrated policy efforts. However, resistance to change is foreseeable and should not be underestimated. Short-term horizons and political interests generate incentives to free-riding on other countries' action and slow – if not stop – the decarbonization process. For example, carbon taxes could be opposed – as in Japan and Australia[5] – because they are held to unilaterally harm domestic producers and consumers to the benefit of foreign companies or future generations. Therefore, while opinion polling indicates public awareness of climate changes and GHG contribution to it, support for strong corrective measures is still limited.

In the paper, we analyze whether an effective anchor to decarbonization policies can be provided by clearly stated constitutional provisions. These principles would contrast political inertia and resistance to change, locking in policymakers' commitment to climate change mitigation. They would also increase the salience of the decarbonization issue and allow "bottom-up" strategies from citizens and associations to induce serious action on climate change. Finally, constitutional provisions would reframe incentives to mitigation policies and boost economic agents' confidence and expectations that environmental policies will be sustained, supporting the switch to lower-carbon production. In fact, "climate policy-making has much to do with the creation and management of economic expectations. The greater the belief among economic actors that the world is shifting towards a low-carbon trajectory, the more likely it to happen - and the more cost effective it will be" (Zenghelis, 2016, 185).

By extending the literature on environmental performance determinants and constitutional environmental rights, we explore the role of economic and institutional factors in affecting CO2 emissions by applying a pooled OLS on a sample of 168 countries covering different geographic areas over the period 2010–2014. To the best of our knowledge, for the first time, the institutional characteristics are analyzed simultaneously together with confirmed determinants, specifically to check their effects on emissions. In our analysis, environmental constitutional prescriptions are proved to be a useful anchor to bring about the decarbonization revolution.

Conceptually, given the global public good nature of decarbonization, a world constitution should be envisaged. Yet, for feasibility reasons, we conceptualize a European environmental constitution, whose compulsory provisions would reinforce its member states' still weak legislative framework for domestic decarbonization policies and would give citizens and non-governmental organizations the possibility to appeal to the competent courts and compel their governments to implement stricter emission reductions. Finally, an EU environmental constitution would be an instrument of moral suasion all over the globe.

The outline of the paper is the following. Section 2 reviews the literature and introduces the problem of constitutionalizing atmospheric integrity. Section 3 describes the current constitutional provisions for environmental protection, while Section 4 presents the data selection and the empirical evidence. Section 5 concludes.

2. Institutions and decarbonization: stylized facts and literature review

Governments' willingness to engage in combatting climate change policies has been deployed in multi-national agreements (EU-ETS) and global agreements (Kyoto Protocol, Paris Agreement). This willingness is fed by the increasing awareness of the costs of the high-carbon model of development, the perception that risks are mounting faster than expected, and the pros of low-carbon policies in terms not only of climate mitigation but also of better and inclusive growth (NCE, 2014). Besides, technological innovation and falling costs of renewable energy are increasing the attractiveness of sustainable investments, to the point that many are now more cost competitive than traditional fossil fuel-based technologies (NCE, 2018).

However, effective and efficient instruments are still not deployed on an adequate scale. OECD (2018a) reports that few countries price a significant share of their emissions above EUR 30 per ton CO2 - a low-end estimate of the damage that carbon emissions cause to society - meaning that emitters are not directly confronted with the full cost of emissions and the incentives for cost-effective abatement are too weak. Besides, the variability in implementation of emissions regulation and in prices for carbon emissions, dampens investments in clean energy sources. Indeed, while most European countries decreased their carbon emissions in the last decades, other countries present both higher levels of emissions and a larger rate of change. For example, from 1994 to 2014, GHG emissions increased by 153% in Kuwait, 211% in Saudi Arabia and 300% in China (CAIT, 2017).

The first obstacle to decarbonization is its global public good (GPG) nature. The global and public connotations[6] and the aggregation technologies of GPGs – i.e. the relationship between individual contributions and the overall level of the goods - impose limits on collective actions for provision. In particular, actions for decarbonization are GPGs with summation technology (Kaul, 2012), whereby countries' contributions are perfectly substitutable and determine, by addition, the aggregate level of provision: free-riding problems are, therefore, extremely relevant and determine too little action. Although every country would benefit from effective policies against climate change, regardless of whether it contributes or not, it has incentives to delay actions, hoping that others will solve the problem. A further aggravating factor is non-simultaneity of cost and benefits that decarbonization involves: while the costs are immediate, the benefits will be enjoyed by people living far in the future. Finally, the very unequal distribution of emissions and climate change consequences further reduce incentives to action.

Reaching an agreement in presence of strong free-riding incentives is complex. Credible compliance mechanisms (e.g. multi-lateral sanctions), incentives to participation in international agreements and effective monitoring systems would be required, but they are not easily identifiable. Consequently, climate agreements risk being insufficient to deter non-compliance; at most, they weakly deter no-participation (Barrett, 1998).

A second major obstacle to decarbonization lies in domestic politics, where different policy frames are all conducive to little action. The first frame rests on the domestic conflict of interests (Kollmann and

[3] https://ipcc.ch/pdf/session48/pr_181008_P48_spm_en.pdf.

[4] https://www.iea.org/topics/climatechange/

[5] In Japan carbon taxes were proposed in 2005 and 2009, but successfully opposed by industry groups. In 2012, the Australian Federal government introduced a carbon price on selected fossil fuels, but the tax was abolished in 2014.

[6] The 'global' connotation identifies: i) the world population including future generations; and ii) the jurisdiction responsible for the supply, which is the international community. The 'public' connotation implies that GPGs provide benefits that are non-rival and non-excludable in consumption.

Schneider, 2010) between those who favor decarbonization – unorganized citizens, environmentalists and the green energy industry – and producers lobbying against the deployment of environmental-friendly policies. Politicians, trying to engage in arbitrage to solve this conflict, often resort to announcements or highly visible policies, but then weaken or fail to implement them. The second frame sees public opinion mildly supporting decarbonisation but opposing increases in the energy price, while carbon-emitting industries lobbying against. In democracies, the median voter of the current generation generates again a malign policy of too little action (Keohane, 2015). Finally, political partisanship may use environmental policy into a wedge issue to mobilize the electorate – as in the US (Bryner, 2008) –, while environmental interest groups strive to block or advance legislation but are not strong enough to oppose powerful coalitions of carbon-dependent industries and launch an effective strategy against climate change.

To overcome these obstacles, a new framing of the decarbonization issue is required, in order to make decarbonization policies more stringent. Indeed, policy stringency impacts on CO2 emissions reduction performance, as shown by a preliminary analysis using the Climate Laws, Institutions and Measures Index – CLIMI (Steve and Teytelboym, 2013) (Fig. 1). Countries that score higher in the index also show larger reductions or smaller increases of CO2 emissions. However, as Steves and Teytelboym's (2013) remark, the relationship between emissions, instruments and policy commitment is not straightforward for several reasons, including poor institutional capacity, conflicting objectives, overlapping policies and instruments, lack of long-term strategies.

On its turn, stringency requires increasing the salience of climate change and finding effective anchors to public decision-making. However, anchoring decarbonization actions is costly, not only because it may imply a loss of political consensus, but also because it reduces flexibility in policy responses when relevant parameters – global warming damage, technological innovation or abatement costs – change (Brunner et al., 2012). On the other hand, discretionary policies disincentive investments in renewable energy sources and slow the decarbonization of the energy sector (Habermacher and Lehmann, 2017). According to Jakob and Brunner (2011), when trying to strike the balance between commitment and discretion, the time-consistent and optimal solution would be a state-dependent policy that determines the amount of emissions abatement contingent on the realization of an uncertain variable. However, the presence of asymmetric information is a fundamental obstacle to the implementation of this first-best solution. The second best is full commitment to an inter temporal environmental policy: choosing an adequately ambitious climate policy today is more important than the way policy makers commit to it across time. Still, the open question is how to root commitment. Out of the three main types of commitment devices (Brunner et al., 2012) – legislation, delegation, and securitization – we focus on the first one.

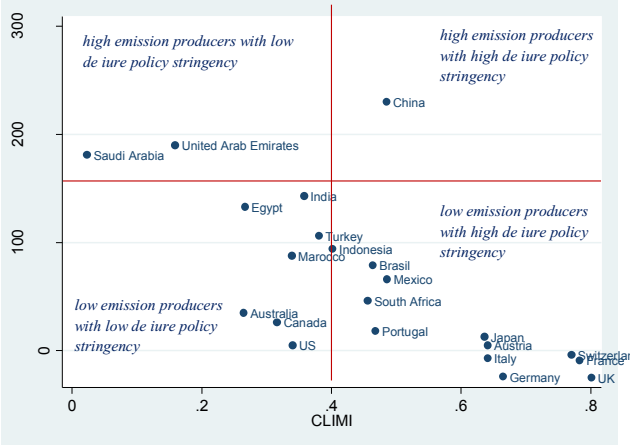

Fig. 1. CO2 emissions: change (%) (1990–2012) and CLIMI index.
Source: Authors' elaborations.

Legislative devices are useful to increase the salience of decarbonization and strengthen commitment, but the legal quality of these provisions influences their level of credibility. Constitutional provisions are, indeed, the most robust, because they cope with the individual akrasia, the myopic view and the need for stable expectations in an interdependent choices' context. Thanks to the larger majority needed in any constitutional change, politicians cannot erode these provisions by pursuing their interests (Buchanan and Brennan, 1980) and the long-run goal of decarbonization would be protected from daily politics. The constitutional allure represents also a stronger protection in front of the judiciary and constitutional courts.

3. Constitutions: from environmental rights to atmospheric integrity protection?

Constitutions have no specific references to climate change[7], rather a generic recognition of constitutional environmental rights, which have been included after their international acknowledgment in the 1970s. The Stockholm Declaration (1972) stated that environmental quality was the *sine qua non* condition for human rights enjoyment and introduced an individual responsibility for environment protection for present and future generations. The recognition of State responsibility for non-action found place later (Resolution 45/94 UN General Assembly) and in 1986 the *right to environment* was proclaimed in the Bundtland Report. Soon after, it was downgraded to an entitlement to "a healthy and productive life in harmony with nature" by the Rio Summit, a line which has not been modified yet.

Constitutional provisions include substantive and/or procedural rights and duties for environment protection (Boyd, 2012). Substantive rights imply that the environment is considered a right essential for the promotion of individuals' wellbeing and plays a fundamental role for the material, social and existential development of the person. Procedural rights – introduced by the Aarhus Convention (1998) – indicate the right to be informed, participate in decision-making or challenge decisions. Regarding duties, the main question is if responsibility for environmental protection is shared among individuals and government or attributed to them singularly.

All these rights are significantly correlated (Table 1), which implies that countries tend to rely not on a single provision, rather on a broader set of instruments to protect the environment. At the European level, this phenomenon is evident when observing the correlations with substantive rights. In particular, 15 out of 28 member states[8] protect a right to a healthy environment, which is accompanied by procedural rights only in half of the cases[9]. Regarding duties, most countries (20/28) include the government's responsibility, which is complemented by individual responsibility in nearly half of the cases. Only five countries incorporate all rights and duties in their constitutions.

To summarize the position of the EU countries, we employ Boyd's (2012) index of the constitutional strength in environment protection, which we complete with the addition of Jeffords (2013) category for the relevance of future generations (Fig. 2). At the base of this composite index (that ranges from 0 to 5), one best performer (Poland) and four other second best performers – Portugal, France, the Czech Republic and Slovakia – are identified.

In principle, only the inclusion of a concern for future generations – in line with the principle of inter- and intra-generational equity – could be considered as a constitutional provision reflecting climate change concern (Levy and Patz, 2015). In this respect, up to 2010, only 36 out

[7] The only exception is the Nepalese constitution, adopted in September 2015, introducing the right regarding clean environment.

[8] Table 1 (Supplementary material) describes environment constitutional provision in the EU.

[9] Table 2, Supplementary material

Table 1
Correlations among rights and duties of environment protection.
Source: * Significant level: 0.10. Authors' elaboration on Boyd's (2012) database.

	Substantive rights	Procedural rights	Individual responsibility	Government duty
All countries				
Substantive rights	1.000			
Procedural rights	0.4209*	1.000		
Indiv. responsibility	0.3863*	0.3206*	1.000	
Gvt duty	0.5872*	0.2640*	0.3938*	1.000
EU countries				
Substantive rights	1.000			
Procedural rights	0.3591*	1.000		
Indiv. responsibility	0.5000*	0.3213	1.000	
Gvt duty	0.5330*	0.2820	0.2345	1.000

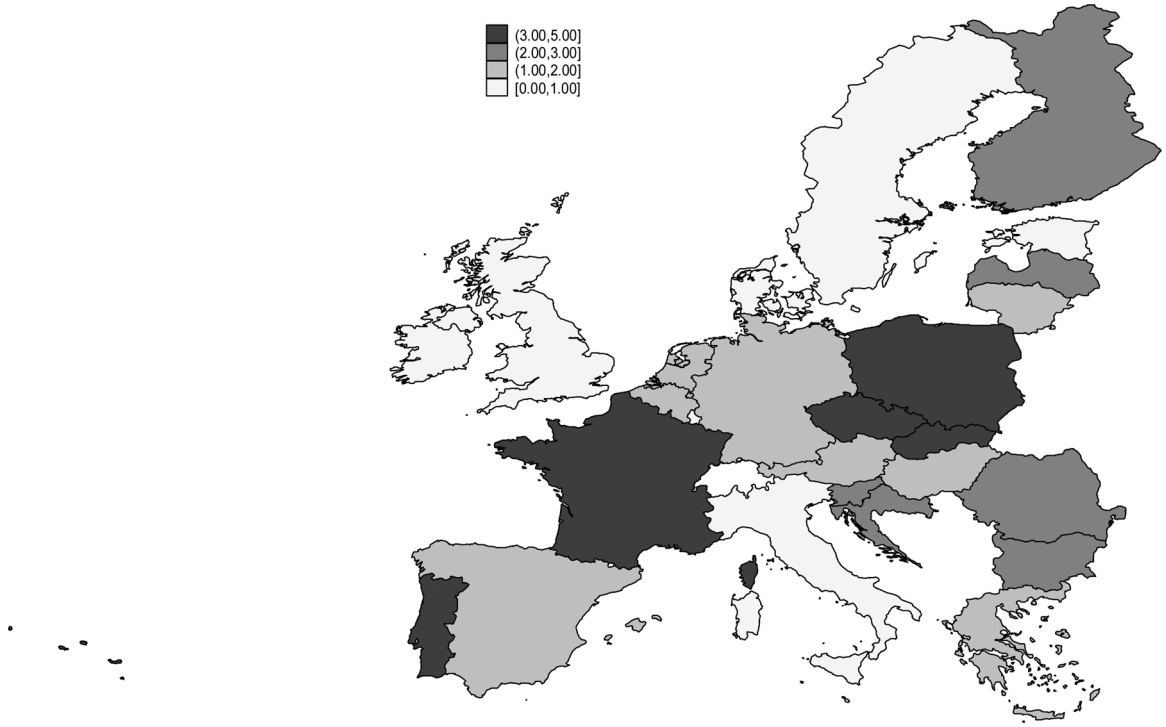

Fig. 2. Constitutional strength of environment protection (EU-28).
Source: Authors' index (0–5) of constitutional strength based on Boyd, 2012 and Jeffords, 2013.

of 142 examined countries included this provision (in Europe, only Poland and Germany). In the absence of constitutional rights to atmospheric integrity, countries rely on targets imposed by ordinary law – the first one being the UK Climate Change Act[10] – and the current set of constitutional environmental rights.

However, strengthening constitutional rights to atmospheric integrity could build long-term interest in climate change actions, public scrutiny and check short-term political opportunism. Constitutional provisions could increase the potential for judicial review and the success of filing suit against non-compliant governments or large fossil fuel companies. Even if these actions have so far been isolated, changes in courts' jurisprudence are beginning. The Deutsche Umwelthilfe association has filed 28 lawsuits against German cities for failing to implement the EU limits on nitrogen dioxide emissions. A ruling by the federal administrative court in February 2018 has allowed local governments to impose diesel bans, while a court in Stuttgart compels the Land's authorities to prepare a clean air plan and ban Euro5 diesel cars.

In two recent cases, *Urgenda vs Netherlands* and *Leghari vs Pakistan* the higher courts of the Netherlands and Pakistan ruled against their respective governments because of unlawful delay in action in climate change policy. In 2013, the Urgenda Foundation filed a lawsuit against the Dutch government for not adequately curbing emissions (Cox, 2015). Dutch climate policies, that targeted a 16% reduction of GHG emissions at the end of 2020, were considered inadequate and unlawful by the Hague District Court, which imposed a 25–40% target. The Court stated that Urgenda could not directly derive rights from the Dutch constitution and signed international treaties. However, the state's duty of care and limits to the government's discretionary powers in climate change mitigation could be deducted and implied that the country's climate policy had to meet the conditions that the Dutch government had previously acknowledged (Kyoto Protocol) as essential for averting dangerous climate change. On October 9, 2018, the Hague Court of Appeal upheld the 2015 decision.

In the Pakistani case, the delay in implementing the 2012 National Climate Policy and Framework was considered by the Court as an offense to the fundamental rights to life protected by the Pakistan Constitution and threatened by climate change. Therefore, it was

[10] The UK Climate Change Act of 2008 combines two commitment devices: legally-binding targets for emission reductions and delegation of monitoring to an independent advisory body that can recommend the parliament to adjust abatement targets.

Table 2
Variables employed in the model.
Source: Authors' elaborations.

	Variable	Source	Expected sign
Economic	log_*GDP*, GDP per capita	WDI	(+)
	service, Service oriented economy	World bank	(−)
Structural	*popgr*, Population growth	WDI	(+)
	risk, Climate risk index	Germanwatch	(−)
Institutional	*demo*, Democracy	Freedom house	(−)
	federal, Federal country	Boyd, 2012 + Jeffords, 2013	(+/−)
	const_str, Constitutional strength	Boyd, 2012 + federal	(−)
	const_rank, Constitutional rank		(+/−)
Governance	*corrupt*, Control of corruption	QOG	(−)
Public awareness	*literacy*, Adult literacy	WDI	(−)

ordered the creation of a cross-sectorial Climate Change Commission to monitor climate policy implementation. In 2015, a similar case was raised by the Belgian NGO Klimaatzaak ASBL against government's inaction and is still pending.

The drawback of judicial procedures is that they are time-consuming and "the deviating government may be long out of office before the courts sanction a judgment of non-compliance" (Brunner et al., 2012, 11). However, the visibility of the constitutional norm and the fear of public scrutiny could increase the political costs of government's inaction or non-compliance with legislated commitments.

4. Strengthening the Paris Agreement: a European constitution for decarbonization

So far, the EU has played a leading role in combating global warming, cathalysing the commitment of other global players at international level. Strong pressure from national public opinion and competition for leadership between the EU Commission, the European Parliament and key member states have sustained the commitment to ambitious decarbonization goals (Schreurs and Tiberghien, 2007). The EU strongly supported the Kyoto Protocol and the Paris Agreement and set the most ambitious target of GHG reduction. However, no agreement exists to include environmental rights at EU Treaty/Constitutional level.

Nevertheless, throughout the years the EU treaties have established a common environment policy. The Council of Europe prepared a model of environmental framework legislation (Boyd, 2012) already in the early 1990s. The Single European Act introduced the legal basis for it, namely general environmental guidelines (Article 191.2): the principles of precaution, prevention and rectifying pollution at source, and the 'polluter pays' principle. The Maastricht Treaty (1993) made the environment an official EU policy area. The Amsterdam Treaty (1999) established the duty to integrate environmental protection into all EU sectorial policies intending to promote sustainable development. Finally, in the Lisbon Treaty (2007), Article 191.1 was amended to include combating climate change among the EU's policy objectives. At the same time, the EU Commission implemented a strong climate policy - the EU ETS - and was granted a coordination and enforcement role with respect to member states' abatement plans.

However, if it is true that the EU environmental provisions are extensive, they have not been able to bring about uniform environmental legislation and jurisprudence in EU member states. The (non-binding) minimum standards for environmental inspections adopted by the EU in 2001 to counteract the wide disparity in the level of implementation among member states have not proved sufficient. We, therefore, argue that implementing decarbonization in the EU requires rooting principles of environmental protection and rights to atmospheric integrity at the constitutional level. Indeed, the symbolic and programmatic function of constitutional norms has a deep impact on legislation, education and promotion of environmental values. EU constitutional provisions could then guide national policy action in member states and provide a global model.

4.1. The model

To analyze the possible effects of constitutional provisions for decarbonization, we draw insights from the empirical literature on the influence of constitutional rights on environmental performance outcomes and the strands focusing on the drivers of environmental performance and policy stringency. Constitutional environmental rights positively affect environmental outcomes, either measured by the Yale's Environmental Performance Index-EPI (Emerson et al., 2012) or via the percentage of the population with access to improved water sources[11] (Gellers and Jeffords, 2015). Both stringency and regulatory structure explain cross-countries differences in environmental performance independently from the performance measure employed (Esty and Porter, 2005).

We, thus, proceed to analyze the determinants of environmental performance using a pooled OLS model (Eq. 1), over a sample of 168 countries covering different geographic areas over the period 2010–2014:

$$log_CO2_i = \beta_0 + \beta_1 \log GDP_i + \beta_2 popgr_i + \beta_3 federal_i + \beta_4 const_str_i + \beta_5 corrup_i + \beta_6 service_i + \beta_7 demo_i + \beta_8 literacy_i + \beta_{10} risk_i + \varepsilon_i \quad (1)$$

The dependent variable is the logarithm of CO2 emissions (log_CO2) - including land-use change, forestry and agriculture - from CAIT Climate Data Explorer. The environmental performance outcome may depend on the general country context, as observed by Esty and Porter (2005); Fiorino (2010) and Apostoaie and Maxim (2017). First, we control for the relation between environmental performance and economic development, which relies on the measure of the environmental performance used[12]. Following the mainstream theories, we employ the natural log of real GDP per capita ($\log GDP_i$) in order to avoid problems of heteroscedasticity (Jeffords and Minkler, 2016; Gallego-Álvarez et al., 2014). Following Apostoaie and Maxim (2017), we then control for the structure of the economy. They find that service-oriented economies are more environmental friendly. Therefore, we add the share of services in the economy using the corresponding World Bank indicator (*service*). As total emissions may rise with population (Selden and Song, 1994), we include the population growth (*popgr*).

Political regimes influence environmental quality, performances and participation in environmental agreements. In general, democratic

[11] For a survey of empirical results, see Jeffords and Gellers (2017).

[12] While a positive effect is found when considering measures of deforestation, soil erosion (Midlarsky, 1998), particulate concentration, SO2 concentration, energy usage (Esty and Porter, 2005) and a more general index of performance (Gallego-Álvarez et al., 2014), a negative one characterizes the air quality measured by CO2 emission (Midlarsky, 1998).

Table 3
Regressions results.
Source: Authors' elaborations. Note: Robust standard errors, significance level: * p < 0.1, ** p < 0.05.

	(1) log_CO2	(2) log_CO2	(3) log_CO2	(4) log_CO2	(5) log_CO2	(6) log_CO2	(7) log_CO2	(8) log_CO2	(9) log_CO2	(10) log_CO2
log_GDP	0.91**	0.92**	0.95**	0.95**	0.97**	0.99**	0.97**	0.97**	0.97**	0.96**
	(112.84)	(114.82)	(81.07)	(71.30)	(80.96)	(73.75)	(71.21)	(54.76)	(51.14)	(48.74)
popgr		0.11**	0.08**	0.08**	0.05**	0.10**	0.09**	0.08**	0.08**	0.09**
		(7.15)	(3.56)	(3.56)	(3.66)	(5.78)	(4.41)	(3.78)	(3.82)	(4.13)
const_str			−0.04**	−0.04**	−0.09**	−0.10**	−0.10**	−0.09**	−0.09**	
			(−2.10)	(−2.11)	(−5.44)	(−6.18)	(−6.11)	(−4.56)	(−4.59)	
federal				0.006	−0.01	−0.08	−0.05	−0.17**	−0.17**	
				(0.09)	(−0.23)	(−1.28)	(−0.77)	(−2.01)	(−2.03)	
corrup					−0.01**	−0.02**	−0.01**	−0.01**	−0.01**	−0.01**
					(−13.30)	(−12.91)	(−10.95)	(−8.73)	(−8.56)	(−8.19)
demo						0.06**	0.09**	0.09**	0.09**	0.09**
						(5.14)	(6.58)	(5.86)	(5.79)	(5.41)
service							−0.01**	−0.01**	−0.01**	−0.01**
							(−3.51)	(−3.72)	(−3.74)	(−3.73)
literacy								0.0002	0.0006	0.0006
								(0.12)	(0.30)	(0.26)
risk									−0.0006	−0.0009
									(−0.57)	(−0.80)
1const_rank										−7.05**
										(−18.22)
2.const_rank										−6.92**
										(−19.70)
3.const_rank										−6.71**
										(-19.25)
_constant	−6.85**	−7.14**	−7.58**	−7.57**	−7.05**	−7.52**	−6.95**	−6.86**	−6.78**	.
	(−69.15)	(−69.21)	(−54.11)	(−49.22)	(−48.32)	(−41.04)	(−31.17)	(−23.27)	(−20.09)	.
N	3854	3845	939	939	931	931	892	715	709	709
R^2	0.73	0.74	0.81	0.81	0.88	0.88	0.88	0.84	0.84	0.84

regimes are keener to provide public goods, such as environmental protection, and allow for more environmental-friendly parties' participation in the decision-making process. However, empirical findings are mixed (Dasgupta and de Cian, 2016). Apart from statistical issues related to sample and quality of data, results depend on the non-homogeneous characteristics of environmental quality, which implies that "not all aspects of environmental quality are expected to respond equally to the sharing of power associated with democratic regimes. […] Problems that have immediate and clear effects on the health or livelihood of many people, […] are more likely to be controlled. Problems with distant, unclear or uncertain impacts or that affect fewer people, are less likely to be controlled in a democracy" (Winslow, 2005, p.871). The Freedom House Index of the Quality of Government is employed in our model (*demo*). As the effectiveness of the democracy relies on governance, we also consider the level of corruption control (*corrupt*).

Strictly related to these aspects is the role of public opinion. Indeed, the electorate guides the demand of public goods and policies, so, following Duit (2005) and Gallego Álvarez et al. (2014), we consider the connection between the level of education and environmental performance. We employ the adult literacy obtained from the World Development Indicators database (*literacy*). As public opinion sensitiveness ought to increase on the basis of the level of exposure and vulnerability of the country, the Global Climate Risk index (*risk*) provided by Germanwatch is also added in our regressions.

Then, in order to check how constitutions affect the countries' ability to deal with environmental problems, we introduce an index for constitutional strength (*const_str*) built by summing up the information in Boyd (2012) and Jeffords (2013). Previous findings by Jeffords and Minkler (2016) conclude that Jeffords (2013) index alone is not always significant.

Our focus on the EU prompts us to employ a dummy for federal/multi-level governance (*federal*). In general, environmental policies is a joint activity, based on centrally determined standards, with the responsibility for implementation lodged with state or provincial governments. We do not have any prior on the sign of the variable, given that previous studies find that, in general, institutional factors (except electoral rules) do not impact on environmental performance (Scruggs, 2003; Harrison and Sundstrom, 2010; Poloni-Staudinger, 2008; Fiorino, 2010). Indeed, political institutions that diffuse authority and create veto points make it easier for the status quo to prevail. Among them, federal/multilevel governance may be obstructive of national action, if subnational governments have a veto with respect to key decisions or resources or if they sacrifice environmental quality in their jurisdictions in a "race to the bottom" to attract new business investments and create new jobs (Konisky, 2007; Woods, 2006). However, in the face of national inaction, federalism allows some subnational governments to act, to the extent there is regional variation in electoral incentives (Harrison and Sundstrom, 2010)[13]. Besides, in some circumstances, local governments engage in a beneficial "race to the top", raising environmental standards. According to Walti (2004), multi-level governance correlates positively with environmental outcomes, but the specific effects depend on the country's income and the extent of corporatism[14]. Other case studies claim that federalism inhibits environmental policies (for biodiversity conservation in Canada, see Campbell and Thomas (2002)). Finally, we further check our results by adopting a different perspective that considers the strength of environmental rights in terms of their rank in the constitutional order. Therefore, we build a categorical variable that combines the constitutional strength of environmental rights and the government's federal or state level that recognizes them. The variable assumes value 1, when

[13] In Canada, federalism has been an important obstacle, as provincial governments have fought to protect the interests of local industries (Harrison and Sundstrom, 2007). On the contrary, it helped to create a "multiple competitive dynamic" in the US (at least at the state level) and the EU.

[14] Corporatism is found to be more important in strong federal countries like Canada or the US (Walti, 2004). Scruggs (2003) finds that countries characterized by a more consensual approach to policymaking have enjoyed better environmental performance. See also Liefferink et al. (2009).

environmental constitutional rights are recognized at federal level, value 2 when recognized at state's level and 0 in case they are not recognized at all. Again, we do not form any prior on their expected sign. Table 2 summarizes the variables employed and the expected signs of their coefficients.

Tables 3 presents the regression results. CO2 emissions are found to increase with development as well as with population growth. As in Midlarsky (1998), the degree of democratic development does not contribute to carbon emissions reduction, while a positive effect (lower emissions, as shown by the negative sign) is confirmed for the higher contribution of services in the economy, as in Apostoaie and Maxim (2017). Still, as in Gallego-Álvarez et al., 2014, better governance, through tighter corruption control, is significant with the expected sign, while higher awareness of environmental issues due to population literacy does not seem to play any role. Countries' vulnerability is non-significant, although with the expected sign. Finally, as expected, both the federal status and the constitutional strength in environmental matters play a role in diminishing carbon emissions[15]. The negative coefficient for federalism seems to confirm previous findings (Walti, 2004; Poloni-Staudinger, 2008), suggesting that decarbonization goals may have more leverage in multilevel systems.

When replacing *const_str* and *federal* with *const_rank*, the variable that combines the constitutional strength of environmental rights and the government's level that recognizes them, we observe significant differences (Table 3, Model 10). Indeed, environmental rights granted at federal level have a larger effect in terms of carbon emissions reduction.

Robustness checks are performed using a different measure of emissions (total GHG emissions including land-use change and forestry, log*GHGE*), as well as a more general environmental measure of performance, the EPI index (*epi*) which encompasses two dimensions of environmental performance, namely eco-system vitality (*epi_ev*) and environmental health (*epi_eh*) (Appendix, Table A1). In the latter cases, the signs must be interpreted conversely (a positive sign implies an improvement while a negative sign a deterioration), as an increase in the EPI indices implies an improvement of the performance. Almost all results are confirmed, except for the federal status, which appears to have a negative effect on the environmental performance index. Given that EPI index has a 50 per cent ecosystem vitality component, this result confirms previous findings (Campbell and Thomas, 2002), whereby diffusion of authority via federalism inhibits certain environmental policies (e.g. biodiversity conservation) when local governments control key natural resources and protect the interests of local industries.

5. Conclusions

International treaties on climate change have marked a fundamental step in the global decarbonization process. Pressure from public opinion, governments' "green" orientation and the treaties' highly symbolic value led countries to ratify. However, this is not sufficient to guarantee that the necessary abatement policies are implemented, when confronted with interest groups' pressure, electoral incentives and institutional obstacles. Carbon policy in most countries still lacks credible commitment to long-term objectives. We, therefore, suggest that constitutional anchors for policy-makers should be introduced to complement external anchors (international climate agreements), increase the salience of the issue with voters and root effective decarbonization policies. In the same line of Steves and Teytelboym (2013), we focus on institutional characteristics - the institutional capacity to reduce emissions in the future - on which climate policies and measures are based. In our model, environmental constitutional prescriptions are confirmed to be a useful tool for policymakers in the climate change field. Constitutionalizing decarbonization could generate demand for political action, overcome the policy deadlock, impose more ambitious emissions reduction targets and enable the judiciary to enforce them.

The focus on institutions prompts us to analyze the effect of multi-level governance on environmental choices. Multi-level governance offers multiple points of access for environmental advocates, is more responsive to citizens' preferences and creates competition among institutions that can promote decarbonization. On the other side, the number of actors, ideological polarization and less coherent policy-making increase the transaction costs of a policy change and favor the status quo. Our findings show that multi-level governance is a co-player in ensuring emissions decrease, although its contribution is not clear when more general environmental performance outcomes - such as ecosystem vitality – are considered.

We, therefore, advocate the inclusion of rights to atmospheric integrity at the EU constitutional level, to lock-in decarbonization policies in member states. Indeed, in a system with multiple veto points like the EU, the respect of salient targets, resulting from costly negotiations and embedded at the constitutional level, benefits from widespread oversight and pressure.

Timely interventions are fundamental elements in climate policy and constitutional norms for decarbonization would ease their adoption. Put at the beginning of the chain from emissions to human welfare, these norms would provide invaluable policy orientation.

Appendix A

Table A1
Robustness checks.
Source: Authors' elaborations. Note: Robust standard errors, significance level: * $p < 0.1$, ** $p < 0.05$.

	(1) log_CO2	(2) log_GHGE	(3) epi	(4) epi_ev	(5) epi_eh
log_GDP	0.97**	0.88**	2.11**	3.68**	1.87**
	(51.14)	(50.25)	(7.11)	(5.83)	(4.74)
popgr	0.084**	0.053**	−1.16**	−0.73	−0.51
	(3.82)	(2.12)	(−3.66)	(−0.84)	(−1.07)
const_str	−0.09**	−0.05**	0.12	1.31**	−0.69**
	(−4.59)	(−3.04)	(0.49)	(2.19)	(−2.05)
federal	−0.17**	0.11	−2.47**	−5.94**	−1.36
	(−2.03)	(1.53)	(−1.97)	(−2.12)	(−0.73)

(*continued on next page*)

[15] This result is confirmed even when considering countries' policy responses to the risk of climate change (Steve and Teytelboym, 2013). Results are available upon request.

Table A1 (*continued*)

	(1) log_CO2	(2) log_GHGE	(3) epi	(4) epi_ev	(5) epi_eh
corrup	−0.01**	−0.01**	0.21**	−0.06	0.28**
	(−8.56)	(−7.63)	(10.13)	(−1.22)	(10.16)
demo	0.09**	0.03**	−0.27	−0.62	−0.57**
	(5.79)	(2.24)	(−1.40)	(−1.42)	(−2.15)
service	−0.01**	−0.01**	0.16**	0.27**	0.37**
	(−3.74)	(−5.90)	(4.53)	(2.76)	(7.58)
literacy	0.001	−0.01**	0.22**	−0.04	0.49**
	(0.30)	(−4.79)	(9.79)	(−0.43)	(16.57)
risk	−0.001	−0.002**	0.08**	0.12**	0.09**
	(−0.57)	(−2.67)	(6.31)	(3.88)	(5.18)
_constant	−6.78**	−4.10**	−12.56**	−11.02	−30.84**
	(−20.09)	(−13.15)	(−3.07)	(−0.82)	(−6.61)
N	709	737	491	356	492
R^2	0.84	0.85	0.66	0.15	0.75

References

Apostoaie, C.M., Maxim, A., 2017. Political determinants of national environmental performance in the European Union. EJSD 6 (1), 277–290. https://doi.org/10.14207/ejsd.2017.v6n1p277.

Barrett, S., 1998. Political economy of the Kyoto Protocol. Oxford Rev. Econ. Policy 14 (4), 20–39.

Boyd, D.R., 2012. The Environmental Rights Revolution. A Global Study of Constitutions, Human Rights, and the Environment. UBC Press [dataset].

Bryner, C., 2008. Failure and opportunity: environmental groups in US climate change policy. Env. Polit. 17 (2), 319–336.

Brunner, S., Flachsland, C., Marschinski, R., 2012. Credible commitment in carbon policy. Clim. Policy 12, 255–271. https://doi.org/10.1080/14693062.2011.582327.

Buchanan, J.M., Brennan, J., 1980. The Power to Tax, Analytical Foundations of a Fiscal Constitution. Cambridge University Press.

CAIT Climate Data Explorer. 2017: http://cait.wri.org [dataset].

Campbell, M.L., Thomas, V.G., 2002. Constitutional impacts on conservation - effects of federalism on biodiversity protection. Environ. Policy Law 32 (5), 223–233.

Cox, R., 2015. A climate change litigation precedent: Urgenda foundation vs the state of the Netherlands. Centre Int. Govern. Innov.

Dasgupta, S., de Cian, E., 2016. Institutions and the Environment: Existing Evidence and Future Directions. Nota Di Lavoro 41. Fondazione ENI Enrico Matteihttps://doi.org/10.13140/RG.2.1.1784.0241.

Duit, A., 2005. Understanding environmental performance of states: an institution-centered approach and some difficulties. QOG Working Paper Series 7.

Emerson, J.W., Hsu, A., Levy, M.A., 2012. Environmental Performance Index and Pilot Trend Environmental Performance Index. Yale Center for Environmental and Policy, New Heaven [dataset].

Esty, D.C., Porter, M.E., 2005. National environmental performance: an empirical analysis of policy results and determinants. Environ. Dev. Econ. 10, 391–434. https://doi.org/10.1017/S1355770X05002263.

European Council, 2018. Council Conclusion on Climate Diplomacy. 26/02/2018, n 6125/18. .

Fiorino, D.J., 2010. Explaining national environmental performance: approaches, evidence, and implications. Policy Sci. 44, 367–389.

Gallego-Álvarez, I., Vicente-Galindo, M.P., Galindo-Villardón, M.P., Rodríguez-Rosa, M., 2014. Environmental performance in countries worldwide: determinant factors and multivariate analysis. Sustainability 6, 7807–7832. https://doi.org/10.3390/su6117807.

Gellers, J., Jeffords, C., 2015. Procedural Environmental Rights and Environmental Justice: Assessing the Impact of Environmental Constitutionalism. University of Connecticuthttps://doi.org/10.2139/ssrn.2646739. Economic Rights Working Paper #1.

Habermacher, F., Lehmann, P., 2017. Commitment vs. Discretion in Climate and Energy Policy, CESIfo Working Paper N.6355.

Harrison, K., Sundstrom, L.M., 2010. Global Commons, Domestic Decisions: the Comparative Politics of Climate Change. MIT Press, Cambridge.

Jakob, M., Brunner, S., 2011. Optimal Commitment Under Uncertainty: Adjustment Rules for Climate Policy. PIK Working Paper.

Jeffords, C., 2013. Constitutional environmental human rights: a descriptive analysis of 142 national constitutions. In: Minkler, L. (Ed.), The State of Economic and Social Human Rights: A Global Overview. Cambridge University Press, New York.

Jeffords, C., Minkler, L., 2016. Do constitutions matter? The effects of constitutional environmental rights provisions on environmental outcomes. KYKLOS 69 (2), 294–335. https://doi.org/10.1111/kykl.12112.

Jeffords, C., Gellers, J.C., 2017. Constitutionalizing environmental rights: a practical guide. J. Hum. Rights Pract. 9, 136–145. https://doi.org/10.1093/jhuman/hux001.

Kaul, I., 2012. Rethinking public goods and global public goods. In: Brousseau, E., Dedeurwaerdere, T., Siebenhüner, B. (Eds.), Reflexive Governance for Global Public Goods. MIT Press, Cambridge.

Keohane, R.O., 2015. The global politics of climate change: challenge for political science. Polit. Sci. Polit. https://doi.org/10.1017/S1049096514001541. 48/1, 19-26.

Kollmann, A., Schneider, F., 2010. Why does environmental policy in representative democracies tend to be inadequate? A preliminary public choice analysis. Sustainability 2 (12), 3710–3734. https://doi.org/10.3390/su2123710.

Konisky, D., 2007. Regulatory competition and environmental enforcement: Is there a race to the bottom? Am. J. Pol. Sci. 51 (4), 853–872.

Levy, B.S., Patz, J.A., 2015. Climate change, human rights, and social justice. Ann. Glob. Health 81 (3), 310–322. https://doi.org/10.1016/j.aogh.2015.08.008.

Liefferink, D., Arts, B., Kamstra, J., Ooijevaar, J., 2009. Leaders and laggards in environmental policy: a quantitative analysis of domestic policy outputs. J. Eur. Public Policy 16, 677–700. https://doi.org/10.1080/13501760902983283.

Midlarsky, M., 1998. Democracy and the environment: an empirical assessment. J. Peace Res. 35 (3), 341–361. https://doi.org/10.1177/0022343398035003005.

NCE, 2014. Better Growth, Better Climate. The New Climate Economy Report, Washington.

NCE, 2018. Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action in Urgent Times. The New Climate Economy Report, Washington.

OECD, 2018a. Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading. OECD Publishing, Paris. https://doi.org/10.1787/9789264305304-en.

OECD, 2018b. OECD Companion to the Inventory of Support Measures for Fossil Fuels 2018. OECD Publishing, Paris.

Poloni-Staudinger, L.M., 2008. Are consensus democracies more environmentally effective? Env. Polit. 17, 410–431.

Schreurs, M.A., Tiberghien, Y., 2007. Multi-level reinforcement: explaining European Union leadership in climate change mitigation. Global Environ. Polit. 7 (4), 19–46.

Scruggs, L., 2003. Sustaining Abundance. Environmental Performance in Industrial Democracies. Cambridge University Press, Cambridge.

Selden, T.M., Song, D.S., 1994. Environmental quality and development is there a kuznets curve for air pollution emissions. J. Environ. Econ. Manage. 27, 147–162.

Steves, F., Teytelboym, A., 2013. Political Economy of Climate Change Policy. SSEE Working Paper 13-02. https://doi.org/10.2139/ssrn.2456538.

Walti, S., 2004. How multilevel structures affect environmental policy in industrial countries. Eur. J. Polit. Res. 43, 599–634. https://doi.org/10.1111/j.1475-6765.2004.00167.x.

Winslow, M., 2005. Is democracy good for the environment? J. Environ. Plann. Manage. 48 (5), 771–783. https://doi.org/10.1080/09640560500183074.

Woods, N.D., 2006. Interstate competition and environmental regulation: a test of the race-to-the-bottom thesis. Soc. Sci. Q. 87 (1), 174–189.

Zenghelis, D., 2016. Decarbonization: innovation and the economics of climate change. In: Jacobs, M., Mazzucato, M. (Eds.), Rethinking Capitalism. Wiley & Sons, Oxford.